5.5.2 Electromagnetic radiation from stars

	Learning outcomes	Additional guidance
	Learners should be able to demonstrate and apply their knowledge and understanding of:	
(a)	energy levels of electrons in isolated gas atoms	
(b)	the idea that energy levels have negative values	
(c)	emission spectral lines from hot gases in terms of emission of photons and transition of electrons between discrete energy levels	HSW2, 8
(d)	the equations $hf = \Delta E$ and $\frac{hc}{\lambda} = \Delta E$	Learners will also require knowledge of section 4.5
(e)	different atoms have different spectral lines which can be used to identify elements within stars	

(6) M - Describe energy levels in isolated atoms
(7) S - Explain emission spectra in terms of transition of electrons between energy levels
(8) C - Explain how spectral lines can be used to identify elements within a star

Energy levels in atoms

STARTER:

a Describe the formation of a star such as our Sun and its most probable evolution. In your answer you should make clear how the steps in the process are sequenced. *(6 marks)*

Extension: Contrast with a high mass star by stating the main differences.

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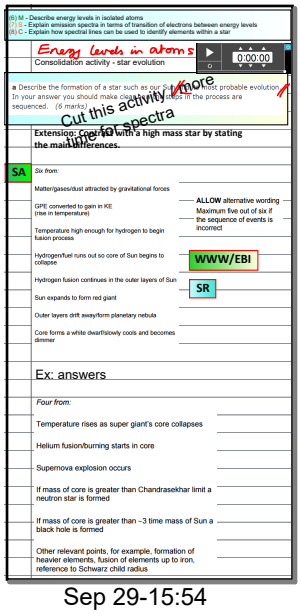

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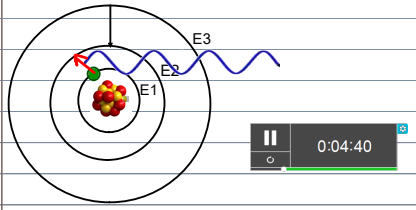
Energy levels in atoms $E_2 - E_1 = E_p$



Electrons are bound in atoms in discreet **energy levels.**

Read 369 and summaries the characteristics and key points about the energy levels.

1. An electron cannot have an energy of value between two levels
2. energy levels are **negative** because external energy is required to remove an electron from an atom.
3. An electron with zero energy is a free electron.
4. The energy level with the most negative value is called the **ground state**.

Q:What is the term for an electron gaining sufficient energy to move to a higher energy level?

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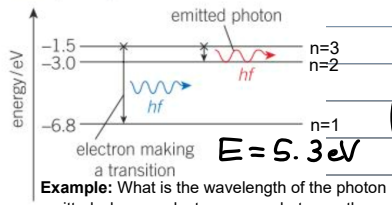
Energy levels in atoms example.



$E = 5.3\,eV$

Example: What is the wavelength of the photon emitted when an electron moves between the highest energy level and the ground state?

$1eV = 1.6\times10^{-19}\,J$ $E = QV$ $E = eV$

E - Photon energy
h - Plank constant
f - frequency.

$E = hf$ $\lambda = \frac{hc}{E} = 2.3\times10^{-7}\,m$

$c = f\lambda$

Activity: Try the summary questions p370 Q3-5

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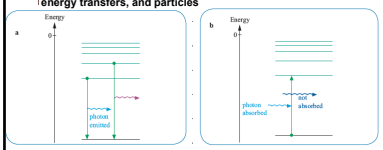
Discussion activity

Describe the **electron transitions**, happening in a and b in terms of **energy transfers, and particles**



Ex: Explain how does this information relate to stars?

a- electron moves from Higher to lower energy level, de-excited, energy lost by electron, photon emitted. Photon energy = energy loss by electron

b- electron moves from lower to higher energy level, excited, electron gained energy, photon absorbed. Photon energy = energy gained by electron

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Activity

1. **Define** a **'continuous spectra'**
2. **Compare and contrast** 'emission spectra and absorption spectra
3. **Sequence** the physical processes that lead to an absorption line spectra (seen below)

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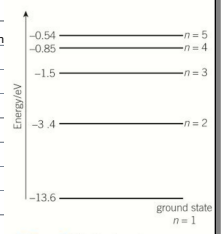
Mini plenary

How many different photon energies can be emitted by this atom?

What type of EM radiation is emitted by

a) the smallest energy change for an electron transition

b) the highest energy change for an electron transition



▲ **Figure 3** *The five lowest energy levels for electrons in hydrogen atoms, labelled with the principal quantum number, n*

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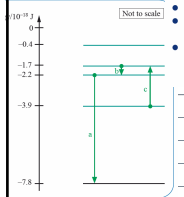
Plenary

Not to scale



- calculate the energy of the photon
- calculate the frequency and wavelength of the electromagnetic radiation (emitted or absorbed)
- state whether the transition contributes to an emission or an absorption spectrum.

Hint
Answer

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